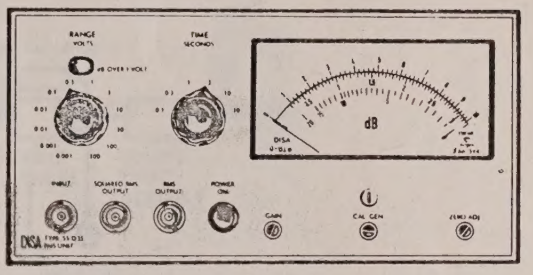
Brüel & KJAER

OPERATION



The DISA Type 55D35 RMS Voltmeter

APPLICATION

The DISA 55D35 All-transistor RMS Voltmeter is designed for measurement of the actual root-mean-square value of AC voltages between 300 V and 300 V_{RMS}, inside the frequency range 1 Hz to 400 kHz. These voltages may be sinusoidal or nonsinusoidal and have crest factors as high as 5 at full-scale deflection and 15 at one-third of full-scale deflection. The ability of the 55D35 Voltmeter to accept waveforms having such high crest factors ensures a high degree of accuracy, even in measurements of nonsinusoidal waveforms such as noise and pulse trains.

The front-panel terminals supply DC voltages proportional to the mean-square and root-mean-square values of the input signal.

The high stability and linearity of these DC voltages permit operation of accessory equipment such as x-y recorders for permanent records or a digital voltmeter for high-resolution measurements.

The 55D35 RMS Voltmeter also permits varying the integrator time constant for best possible response time, depending on the waveform and frequency of the voltage under measurement. The time constant varies from 0.1 to 30 sec.

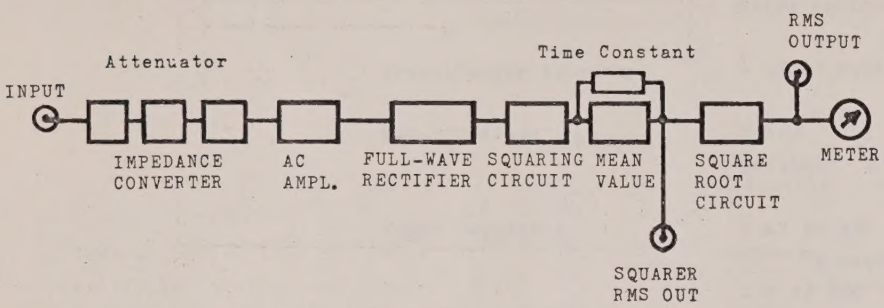
PRINCIPLE

The principle underlying this voltmeter is based on the definition of the actual root-mean-square value of a voltage, e:

$$e_{RMS} = \sqrt{\frac{1}{T}\int_0^T e^2\,dt}$$

The block diagram shows the analog circuits performing the mathematical operations in accordance with the above-mentioned equation. The signal under measurement is applied to the input attenuator. This is followed by an impedance converter, which is a unity-gain amplifier with high input impedance and low-impedance output to drive the second attenuator.

CIRCUIT VALUE
ROOT
CIRCUIT
SQUARE
ROOT



Block Diagram of the 55D35 RMS Voltmeter

The output from the second attenuator is stepped up by an AC amplifier which has very stable gain due to heavy negative feedback. The amplified signal is full-wave rectified and amplified before it is applied to the squaring circuit, which handles positive signals only. The squaring circuit consists of a twelve-diode approximation to the parabola ensuring the dynamic range necessary for handling waveforms with large crest factors. The squared signal is applied to an operational integrator with variable time constant. The DC output voltage from the integrator is proportional to the mean square value of the input signal and is available at a front panel terminal.

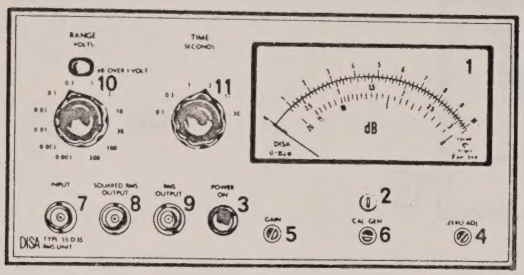
The DC voltage from the integrator is applied to a square root circuit providing current for the meter and a voltage for a front panel terminal. Both the current and the voltage are proportional to the root mean square value of the input signal.

TECHNICAL DATA

Full-scale Ranges:	1, 3, 10, 30, 100, 300 mV, and 1, 3, 10, 30, 100, 300 V
Overload Capacity:	mV ranges up to ± 100 V, and V ranges up to ± 400 V input voltage
Frequency Range:	1 Hz to 400 kHz
Accuracy:	± 1% of full-scale value from 10 Hz to 100 kHz ± 7% of full-scale value from 1 Hz to 10 Hz and from 100 kHz to 400 kHz

Crest Factor:	5:1 at full scale, inversely proportional to pointer deflection, e.g. 10:1 at half-scale deflection
Crest Factor Accuracy:	± 1% of full scale
Meter Scales:	Volts 1 to 10 and 0.3 to 3 Decibels 0 to 20 db over 1 V
Input Impedance:	1 mV to 300 mV range: 1 megohm shunted by approx. 30 pF 1 V to 300 V range: 1 megohm shunted by approx. 10 pF
Squared RMS Output:	- 1 V at full-scale deflection
Squared RMS Output Impedance:	Approx. 1 kohms
RMS Output:	+ 1 V at full-scale deflection
RMS Output Impedance:	Approx. 100 ohms
Time Constants:	0.1, 0.3, 1, 3, 10, and 30 sec.
	Mean Square Output: Time to rise to 63% of final value of a step change. 99% of final value will be reached after approx. 4.6 times the above values. Accuracy: 10%.
	Root Mean Square Output: Time to rise to 63% of final value of a step change is ½ times the above values. 99% of final value will be reached after 2.3 times the above values.
Ambient Temperature:	0 - 45°C.
Power Supply:	110/220 V ± 10%, 50 to 60 Hz.
Power Consumption:	Approx. 12 VA.
Dimensions:	106 mm high, 212 mm wide, 235 mm deep.
Finish:	Pastel green and light gray enamel.
Weight:	3.5 kg.

We reserve the right to make without notice, such changes in our published data as we may deem necessary or desirable.



Front Panel of the Type 55D35

FUNCTIONS AND USE OF CONTROLS AND TERMINALS

FRONT PANEL

(1) Direct reading meter: A meter indicating RMS voltage level of input signal.

(2) Mechanical zero adjustment: Screwdriver adjustment for zero of direct reading meter.

(3) POWER ON: Pilot lamp indicating when power is applied (power switch ON).

(4) ZERO ADJ.: Screwdriver adjustment for electric zero of direct reading meter.

(5) GAIN: Screwdriver adjustment for calibrating the meter with a calibration signal applied through the INPUT terminal.

(6) CAL. GEN.: When this pushbutton is depressed, an internal calibration signal is applied to the AC amplifier, for rough calibration.

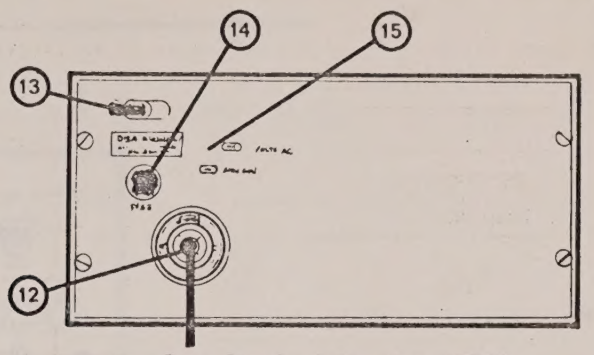
(7) INPUT terminal: BNC jack which enables application of input signal to instrument measuring circuits.

(8) SQUARED OUTPUT: BNC jack. This terminal provides approx. -4 volts DC at full-scale deflection; output is proportional to squared meter deflection. Output impedance is approx. 100 ohms.

(9) RMS OUTPUT terminal: BNC jack which provides approx. +2 volts DC at full-scale deflection; output is proportional to meter deflection. Output impedance is approx. 100 ohms.

(10) RANGE switch: 12-position rotary switch which selects various attenuation ranges.

(11) INTEGRATOR TIME CONSTANT: 6-position rotary switch which selects various time constants.



Rear Panel of the Type 55D35

REAR PANEL

(12) POWER LINE: 3-pin jack for application of line voltage to instrument power supply circuits.

(13) OFF/ON: 2-position power switch which applies 220 or 110 volts AC to instrument.

(14) FUSE: 110V/0.5 A or 220 V/0.25 A fuse which provides protection against line voltage surges.

(15) VOLTAGE SELECTOR: 110/220-volt switch which sets instrument to operate from either 110 V or 220 V AC.

Controls and Terminals etc.

Each control and terminal as well as the pilot lamp on the Type 55D35 is identified and described above.

Turn-on Procedure

(a) As supplied from the factory, the RMS voltmeter is set up for operation from 220 V AC, 50 - 60 Hz. However, it can also be set up for operation from 110 V AC, 50 - 60 Hz. This is done by removing the rear panel of the instrument and turning the line voltage selector switch (15) to the 110 V/0.5 A position. The 220 V/0.25 A fuse must be replaced with the 110 V/0.5 A fuse located near the selector switch.

(b) Power is applied by turning power switch (13) to ON; make sure that POWER ON pilot lamp lights.

(c) Before making any reading where high accuracy is important the 55D35 should be permitted to warm up for approx. half an hour.

OPERATING INSTRUCTIONS

(a) Attach test lead to INPUT terminal (7).

(b) Set RANGE switch (10) at 300 volts.

(c) Connect test lead to point to be measured.

(d) Rotate RANGE switch in a counterclockwise direction (decreased attenuation) until direct reading meter (1) shows reading in upper two-thirds of scale.

(e) Set the INTEGRATOR TIME CONSTANT switch for best possible response time, depending on the waveform and frequency of the voltage under measurement.

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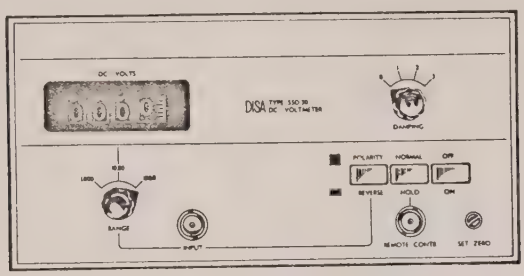


The DISA Type 55D30 Digital DC Voltmeter

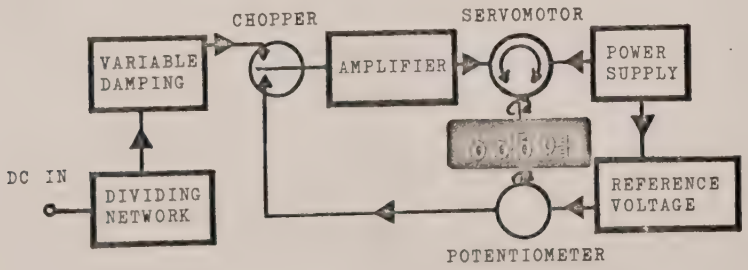
DESCRIPTION

The DISA Type 55D30 Digital DC Voltmeter permits accurate indication of mean flow velocities, using a DISA Constant-Temperature or Constant-Current Anemometer.

This Digital Voltmeter is a fully transistorized instrument. It incorporates a self-balancing servo system and provides digital readout of DC voltages from 1 millivolt up to 100 volts.

A damping circuit with stepwise variable time constant (1, 3, and 10 sec.) permits measurement, inside the limtis determined by the time constant, of the arithmetic mean of the signal from an anemometer whose probe is exposed to a turbulent flow.

Fig. 1 shows the block diagram of the voltmeter. Its mode of operation is as follows:



The DC voltage to be measured is fed through an attenuator and a stepwise variable damping network to one of the input contacts of a mechanical chopper. The opposite chopper input contact receives voltage from a precision potentiometer which is operated by a servomotor. The servomotor also operates a 4-digit counter which thus provides digital readout. A well-defined reference voltage supplied by a double Zener stabilized power supply is present across the precision potentiometer.

From the chopper, an AC signal is fed to a sensitive servo amplifier. Both the amplitude and the phase of this signal are functions of the difference in the magnitude and polarity of the signals at the two chopper inputs.

The amplified signal controls the servo winding of the motor. The other set of motor windings are driven synchronously with the power line frequency.

The phase relation between the servo signal applied to the motor and the power line frequency determines the motor's direction of rotation. A voltage difference between the two chopper inputs will cause the servo-motor to pull the precision potentiometer and the digital indicator rapidly into place, causing the voltage difference between the two inputs to become zero. The indicator will now provide digital readout of the amplitude of the voltage applied.

TECHNICAL DATA

Ranges:	0.000 - 1.000 volt 00.00 - 10.00 volts 000.0 - 100.0 volts
Accuracy:	0.3 % of full scale
Linearity:	0.25 % of full scale
Input Impedance:	1 megohm
Overvoltage Protection:	
AC Suppression:	50 db at 50 Hz
Readout:	Four mechanical digits with automatic decimal indication
Operating Time:	Approx. 4 sec. at full scale (damping = 0)
Input Filter:	3-position filter with time constants of 1, 3, and 10 sec., respectively
Ambient Temperature:	0 - 45°C.
Power Supply:	110 and 220 V $\pm$ 10%, 50 - 60 Hz
Power Consumption:	Approx. 20 VA
Dimensions:	106 mm high, 212 mm wide, 235 mm deep
Finish:	Pastel green and light gray enamel
Weight:	3.5 kg

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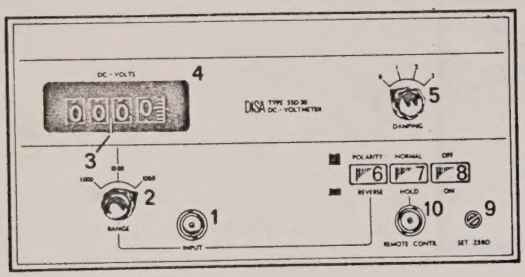


Front Panel of the Type 55D30

FUNCTIONS AND USE OF CONTROLS AND TERMINALS

FRONT PANEL

The picture above shows the front panel of the 55D30 with the functions of the various controls indicated.

(1) INPUT terminal (coaxial connector). Signal to be measured is applied here.

(2) RANGE switch. 3-position switch for selecting ranges of 1, 10, and 100 volts at full-scale deflection.

(3) Automatic decimal point indication.

(4) Digital indicator.

(5) DAMPING control. Permits insertion of a damping circuit consisting of filters with time constants of approx. 1, 3, and 10 sec. The advantage of the damping circuit is that if a DC signal on which AC is superimposed is applied to the 55D30, the digital indicator will be prevented, inside the limits defined by the time constant selected and the AC sensitivity of the system, from cycling around the readout.
The digital indicator now reads the arithmetic mean of the composite signal applied.

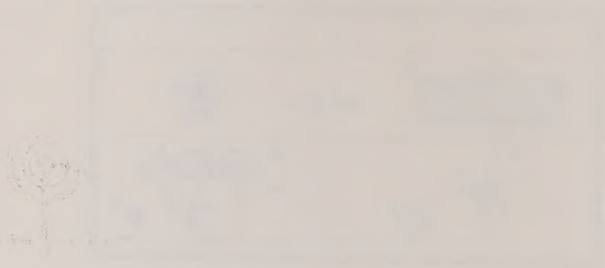
(6) Pushbutton for selecting polarity with repect to ground of the signal applied. With this pushbutton released (POLARITY+) the instrument will measure voltages which are positive with respect to ground.

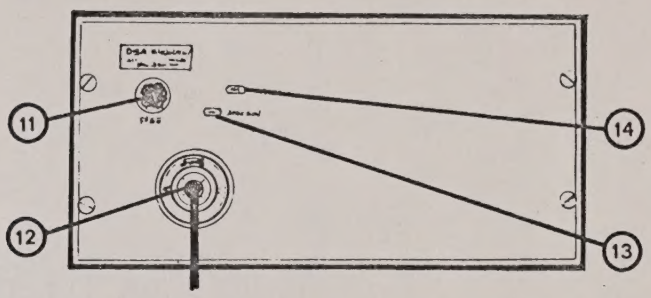
(7) HOLD pushbutton. When depressed holds the readout regardless of voltage changes at the input.

(8) ON/OFF pushbutton switch.

(9) SET ZERO. Screwdriver-operated control for setting the digital indicator to zero with no signal applied at the input.

(10) REMOTE CONTR. terminal. Coaxial connector for a 9006A1871 cable. Permits remote control of the hold function described under (7), with the HOLD pushbutton depressed.





Rear Panel of the Type 55D30

REAR PANEL

(11) Fuse holder. Fuse ratings and type designations are as follows:
0.5 A at 220 V AC - DISA 9133N0007
1 A at 110 V AC - DISA 9133N0010
Both fuses are supplied with the instrument. The fuse not in use is placed on the rear wall. It becomes accessible on removal of the cabinet rear wall.

(12) Power line receptacle.

(13) Fuse rating indicator.

(14) Line voltage indicator.